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Microstructural evolution of deeply buried and surface-piercing Infra-Cambrian Ara Salt from interior Oman: From deposition via burial to uplift

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We present microstructures of Ara salt from the deep subsurface (3 - 7 km) of the South Oman Salt Basin (SOSB) and from three surface-piercing salt domes of the Ghaba Salt Basin. Both sub-basins form the subsurface of interior Oman and belong to the Late Neoproterozoic to Early Cambrian salt belt, which stretches from Oman to Iran (Hormuz Salt).

When comparing samples from the surface and the subsurface, microscopy of gamma-irradiated and doubly polished etched thick sections shows differences in deformation mechanisms and the extent of recrystallisation.

In the subsurface salt, the occasional presence of primary (syn-genetic) chevron crystals indicates incomplete dynamic recrystallization and suggest shallow hypersaline brine pool origin for the salt succession. Those crystals are anhedral in shape and have lobate grain boundaries filled with fluid inclusions and show up to 200 μm-sized subgrains, pointing to dislocation creep processes associated with fluid-assisted grain boundary migration as the dominant deformation mechanisms during burial and diapirism.

In the outcrop, the surface-piercing salt preserved a primary layering (bedding), which is isoclinally folded. However, no primary microstructures like chevron crystals were found, suggesting that the salt fabric is completely recrystallized during extrusion or on the surface. The microstructure is characterized by anhedral crystals with $\sim$ 60

μm-sized subgrains and lobate grain boundaries, showing much less fluid inclusions than the subsurface salt. Fibrous microstructures indicate that solution-precipitation creep was an active deformation mechanism at the surface.

Using subgrain size palaeo-piezometry, the maximum past differential stresses for the subsurface salt is less than 2 MPa and up to 5 MPa for the surface-piercing salt. This stress difference is explained by higher stresses in the extrusion canal of the diapir.

The results show that we can infer different deformation mechanisms from different tectonic settings of a salt diapir. Using data of laboratory deformation experiments, i.e. flow laws, we can implement our findings into models of salt tectonics to take the rheological behaviour into account.